Variation and Distribution of the Intertidal Beetle *Halocoryza arenaria* (Darlington) in Mexico and the United States (Coleoptera: Carabidae)

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Abstract: *H. arenaria* is reported for the first time from North America, with records from Florida and the Yucatan Peninsula. Among characters studied, the most important variation is in wing length. Floridian specimens are flightless and apparently well isolated from those of the West Indies and the Yucatan Peninsula. They also differ in habitat, being found in an intertidal situation rather than at or near the high tide line. Specimens from Quintana Roo are smaller, have fewer elytral setae, and have slightly reduced wings. The most probable routes of dispersal to both mainland areas have been from the Greater Antilles.

INTRODUCTION

Although the American species of *Halocoryza* have been discussed recently (Whitehead, 1966) new collections in Florida and on the Yucatan Peninsula provide valuable insight into problems of dispersal and speciation. In my earlier paper, I suggested that this genus should be present on the Atlantic coast of North America, and further that the species should be the West Indian *H. arenaria* (Darlington). These predictions proved correct. However, *H. arenaria* is much more variable than was anticipated.

NEW RECORDS

To the previously recorded distribution of *H. arenaria* in Puerto Rico and the Dominican Republic are added the following new records:

Mexico. Quintana Roo. Puerto Juarez (20 April, 1966, Ball and Whitehead, 11 specimens). Yucatan. Progreso (19 April, 1966, Ball and Whitehead, 2 specimens).

United States. Florida. Monroe County, Lower Matecumbe Key (21 July, 1967, Whitehead, 21 specimens).

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Table 1. Variation in elytral length, in millimeters.

Locality	Numbers	Range	Mean	1.5 Standard Deviations	2 Standard Errors
Florida	21	1.32–1.45	1.38	0.06	0.02
Yucatan	2	1.35–1.45	1.40	—	—
Quintana Roo	11	1.22–1.38	1.30	0.09	0.03
Puerto Rico	5	1.35–1.45	1.39	—	—

VARIATION

Differences in size and in number of elytral setae that I previously used to separate *H. arenaria* from *H. acapulcana* fail to hold true in these additional samples. In these respects, in fact, the sample from Quintana Roo is virtually identical with the *H. acapulcana* sample from Acapulco, Guerrero, Mexico.

Variation in size was determined by measuring the length of the left elytron, and is summarized in Table 1. Variation in the number of elytral setae was determined by counting the number of setae on interval three of the left elytron, and is summarized in Table 2. The Quintana Roo sample is statistically distinct from the Florida population in both of these measurements.

In my earlier paper, I stated that the wings of *Halocoryza* were fully developed and probably functional. This is not true in some of the new material. Specimens from Florida all have reduced wings, about ¾ as long as the elytra, and are certainly flightless; the elytral humeri are narrow and strongly rounded. Specimens from Quintana Roo have slightly reduced wings, about as long as or slightly longer than the elytra, and the elytral humeri are normal. The two Yucatan specimens have normally developed wings and humeri.

There is no significant variation in other reported characters, and the species *H. arenaria* and *H. acapulcana* remain readily separable by the form of the pronotum and the male genitalia.

BIOLOGICAL NOTES

During 1965–66, G. E. Ball and I visited numerous places on both coasts of Mexico in search of these beetles, but found them only at the Yucatan localities recorded above. In both cases the beetles were found at the high tide line, which

Table 2. Variation in the number of setae on interval three of left elytron.

Locality	Numbers	Range	Mean	1.5 Standard Deviations	2 Standard Errors
Florida	21	10–13	11.5	1.4	0.4
Yucatan	2	11	11.0	—	—
Quintana Roo	11	9–11	10.1	0.3	0.1
Puerto Rico	5	12–13	—	—	—

was marked by thick deposits of seaweed. At the Quintana Roo locality, well sheltered from strong surf, they were generally in fine beach sand under limestone rocks. In the seaweed drift were many specimens of a littoral schendylid centipede, *Pectiniunguis halirrhytus* Crabill (see Crabill, 1959). Since I had previously found this conspicuous centipede in Florida, I had reason to suspect that by using it as an indicator I should also find *Halocoryza* there.

By using *Pectiniunguis* as an indicator, I was able to find a suitable habitat for *Halocoryza* on the Florida Keys. Curiously, though conditions at the Florida locality were much the same as in Quintana Roo, with great mats of seaweed at the high tide line and the surf reduced by an off-shore coral reef, the beetles were found well within the intertidal zone where their habitat was inundated for several hours at each high tide. The beach was a tightly packed conglomerate of coquina, cemented by very fine silt or sand. Water drainage in this material was poor, and hence air entrapment was most probably enhanced. The entire sample was collected in an area not exceeding ten square feet, by scooping out a hole to a depth of three or four inches, filling with water, and stirring in the sides of the pool.

Associated with the *Halocoryza* were numerous small cryptopid centipedes (*Cryptops* sp.), and an unidentified pseudoscorpion (see Muchmore, 1967). No immature *Halocoryza* were found. *Pectiniunguis* was not found in this material, but only associated with drifted seaweed. The only other terrestrial arthropods found in the seaweed were a carabid larva (*Scarites* sp.) and a few staphylinid beetles.

ZOOGEOGRAPHY

Like the centipede *Pectiniunguis halirrhytus*, the carabid *Halocoryza arenaria* seems to be amphi-Caribbean in distribution, and may eventually be discovered on the northeast coast of South America. Since this new material proves my earlier prediction that this species should be found in North America (Whitehead, 1966), certain assumptions concerning the mode of dispersal are given support. These assumptions were that beetles of this genus disperse more readily overwater than over land, and therefore that a major determining factor is the nature of oceanic currents. Since currents in the Caribbean favor transport from the islands to the mainland (hurricane paths follow similar routes), I assume that the islands are probably the center of dispersal for the species.

The dissimilarity of the Yucatan and Florida populations and the apparent lack of habitat continuity along the Gulf Coast suggest genetic discontinuity; if gene exchange occurs it must be sporadic. The flightless Floridian form seems particularly isolated, and obviously cannot form a central gene pool.

Populations from the Yucatan are not as definitely isolated from the islandic populations, and may be more genetically continuous. Probably the peninsular populations are clinal, and I suspect the Progreso specimens are near the limit

of the natural range since the habitat there seems marginal. If so, this might account for a greater similarity to the islandic populations, particularly in wing length, as an adaptation to a relatively poorly protected environment. Fully developed wings should be advantageous for islandic survival, even if long distance flight is relatively unimportant in dispersal.

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